Centre for Computer Science & Technology

Course Structure and Syllabus

For

M.Tech. in Computer Science & Technology (2016-17 Onwards)

Eligibility Criteria: B.Tech/B.E. in Computer Science and Engineering / Information Technology /Electronics / Electronics & Communication from a recognized Indian or Foreign University/ Graduates (AMIETE/AMIE) from Institution of Electronics and Telecommunication Engineers (IETE) in Computer Science & Engineering with minimum 55% marks. Preference will be given to candidates having valid GATE score.

Centre for Computer Science & Technology
Scheme of Programme: M.Tech. in Computer Science and Technology

SEMESTER-I

S.No	Course Type	Paper Code	Course Title	L	T	P	Cr	% Weightage				E
								A	B	C	D	
1.	Foundation	CST.6101	Research Methodology and Statistics	4	-	-	4	25	25	25	25	100
2.	Core	CST.6102	Advanced Data Structures and Algorithms	4	-	-	4	25	25	25	25	100
3.	Core	CST.6103	Advanced Computer Networks	4	-	-	4	25	25	25	25	100
4.	Core	CST.6104	Advanced Software Engineering	4	-	-	4	25	25	25	25	100
5.	Elective-1	CST.6111	Data mining	4	1	-	4	25	25	25	25	100
		CST.6112	Wireless Network and Mobile Computing									
		CST.6113	Cloud Computing and Security									
		CST.6114	Data Analytics and Business Intelligence									
6.	Foundation	CST.6150	Programming in C++	-	-	4	2	-	-	-	-	50
7.	Core	CST.6153	Advanced Computer Networks -Lab	-	-	4	2	-	-	-	-	50
8.	Elective-2	xxxxxxx	Inter-Disciplinary Elective-2 (From Other Departments)	2	-	-	2	10	15	15	10	50
				22			26					650

SEMESTER-II

S.No	Course Type	Paper Code	Course Title	L	T	P	Cr	% Weightage				E
								A	B	C	D	
1.	Core	CST.6201	Information Security	4	-	-	4	25	25	25	25	100
2.	Core	CST.6202	Advanced Database Management System	4	-	-	4	25	25	25	25	100
	Core	CST.6203	Soft Computing	4	-	-	4	25	25	25	25	100
3.	Elective-1	CST.6211	Python programming	4	1	-	4	25	25	25	25	100
		CST.6212	Bioinformatics									
		CST.6213	Advanced Web Technologies									
4.	Elective-2	CST.6314	Biometric Security	4	1	-	4	25	25	25	25	100
		CST.6315	Secure Coding									
		CST.6216	Digital Image Processing									
5.	Core	CST.6252	Advanced Database Management System-Lab	-	-	2	1	-	-	-	-	25
	Elective-1	CST.6261	Elective-1 Lab	-	-	2	1	-	-	-	-	25
8.	Elective-3	XXXXXXXX	Inter-Disciplinary Elective-3 (From Other Departments)	2	-	-	2	10	15	15	10	50
				22		4	24					600

SEMESTER-III

S.No	Course Type	Paper Code	Course Title	L	T	P	Cr	% Weightage				E
								A	B	C	D	
1.	Elective	CST.6399	Research Seminar	-	-	4	2	-	-	-	-	50
2.	Elective	CST.6300	Pre-Dissertation	-	-	-	16	-	-	-	-	400
							18					450

SEMESTER-IV

S.No	Course Type	Paper Code	Course Title	L	T	P	Cr	% Weightage				E
								A	B	C	D	
1.	Elective	CST.6400	Dissertation	-	-	-	16	-	-	-	-	400
							16					400

A: <u>Continuous Assessment:</u> Based on Objective Type Tests
B: <u>Pre-Scheduled Test-1:</u> Based on Objective Type & Subjective Type Test (By Enlarged Subjective Type)
C: <u>Pre-Scheduled Test-2:</u> Based on Objective Type & Subjective Type Test (By Enlarged Subjective Type)
D: <u>End-Term Exam (Final):</u> Based on Objective Type Tests
E: Total Marks
L: Lectures   T: Tutorial   P: Practical   Cr: Credits
Total Lectures for 4 Credit Course: 50-55

SEMESTER I

CST.6101 **Research Methodology and Statistics** **Credits: 4**

Objective: The objective of this course is to ensure that a student learns basis of scientific research and statistical methods to arrive at and verify the conclusions drawn.

Learning Outcomes: Upon completion of this course, the students will be able to:
- Prepare research proposal and plan
- Explain how to interpret data using hypothesis testing
- Describe the concept of multivariate analysis

Unit1

General principles of research: Meaning and importance of research, Critical thinking, Formulating hypothesis and development of research plan, Review of literature, Interpretation of results and discussion. Technical writing: Scientific writing, writing synopsis, Research paper, Poster preparation and Presentations and Dissertation.

Unit 2

Measures of central tendency and dispersal, Histograms, Sampling distribution, Kurtosis and skewness. Probability distributions (Binomial, Poisson and Normal), General Statistics: Hypothesis testing, parametric tests: z test, Student's t-test, Chi-square test.

Unit 3

One-way and two-way analysis of variance (ANOVA), Critical difference (CD), Fisher's LSD (Least significant difference), Non parametric tests: Kruskal-Wallis one-way ANOVA by ranks, Friedman two-way ANOVA by ranks, Chi-square test.

Unit 4

Regression and correlation: Standard errors of regression coefficients, Comparing two regression lines, Pearson Product ó Moment Correlation Coefficient, Spearman Rank correlation coefficient, Power and sampling size in correlation and regression.

Text books:
1. Kothari, C.R. (2013). Research Methodology: Methods and Techniques. New Age International.
2. S.C. Gupta (2014), Fundamentals of Statistics, Himalaya Publishing House

Suggested readings::
1. David J. Sheskin (2011), Handbook of Parametric and Nonparametric Statistical Procedures, Chapman and Hall/CRC.2.
2. Best J. W. (1999). Research in Education, New Delhi: Prentice Hall of India Pvt. Ltd.

CST.6102 **Advanced Data Structures and Algorithms** **Credits: 4**

Objective: This course will provide knowledge related to various data structures and algorithms. The course will also introduce techniques for analysing the efficiency of computer algorithms

Learning Outcome: Upon completion of this course, the students will be able to:
- Identify the properties, strengths, and weaknesses of different data structures
- Examine various existing algorithms
- Distinguish among various data structures

Unit I

Introduction to Basic Data Structures: Importance and need of good data structures and algorithms, Linked lists, Queues, Heaps, Hash tables, Binary search trees.

Unit II

Advanced Data Structures: Red-Black Trees, B-trees, Fibonacci heaps, Data Structures for Disjoint Sets.
Design Strategies: Divide-and-conquer, Dynamic Programming, Greedy Method.

Unit III

Internal and External Sorting algorithms: Linear Search, Binary Search, Bubble Sort, Insertion Sort, Shell Sort, Quick Sort, Heap Sort, Merge Sort, Counting Sort, Radix Sort.
Advanced String Matching Algorithms: The naive string-matching algorithm, Rabin-Karp, String matching with finite automaton, Knuth-Morris-Pratt algorithm.

Unit IV

Graph Algorithms: Elementary graph algorithms, Minimum spanning trees, shortest path algorithms: single source and all pair, Max flow problem and its solutions, Graph coloring problem and its solutions, Bio-inspired algorithms: Swarm Intelligence, Ant Colony Optimization, and recent trends in data structures.

Text books:
1. Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C. 2010. Introduction to Algorithms.3rded. Mit Press.
2. S. Sridhar 2014. Design and Analysis of Algorithms. Oxford University Press India

Suggested readings:
1. Aho, A.V., Hopcroft, J.E. and Ullman, J. D. 2009. Data Structures and Algorithms. India: Pearson Education.
2. Horowitz, E., Sahni, S. and Rajasekaran, S. 2010. Fundamentals of Computer Algorithms. Galgotia Publications.
3. Weiss, M.A. 2009. Data Structures and Algorithm Analysis in C++. India: Pearson Education.

CST.6103   **Advanced Computer Networks**   **Credits: 4**

Objective: This course is designed to discuss recent developments in various fields of networking, including but not limited to, routing, flow control, performance evaluation, transport protocols, application protocols, real-time protocols, and network architectures.

Learning Outcome: Upon completion of this course, the students will be able to:
- Define various networks and their applications
- Identify issues in wired as well as wireless networks
- explain the properties, strengths, and weaknesses of different computer networks and routing protocols

Unit I

Introduction:
Overview of Computer Networks, ISO-OSI and TCP/IP reference models, MAC protocols for LANs, Gigabit Ethernet, Wireless LAN
IPv6: Overview of IP and IPv4, IPv6: Basic protocol, Extensions and options, Tunneling, Addressing, Neighbor Discovery, Auto-configuration, IPv6 in an IPv4 Internet Migration and Coexistence, **Mobile IPv6:** Overview, Route Optimization, Handover and its impacts on TCP and UDP, Security requirements.

Unit II
Transport Layer:
Conventional TCP, TCP extensions for wireless networks
Software Defined Networks:
Introduction, Evolution and Importance of SDN, Control and Data Planes, Role of SDN Controllers, Application areas of SDN.

Unit III
Mobile Computing:
Introduction, Mobile Computing Architecture, Technologies: Bluetooth, RFID, WiMAX, Security Issues in Mobile Computing.
Cellular Technologies:
Cellular Concept: Introduction, Frequency Reuse, Channel Assignment, Handoff Strategies, Interference, Cell Splitting and Sectoring. **GSM:** GSM-services, features, system architecture, **GPRS:** Introduction, network architecture, data services, applications and limitations, 3G and 4G.

Unit IV
Ad Hoc Networks: Introduction to Adhoc networks, Issues in Adhoc networks and Pro-active and Reactive routing protocols. **VANETS:** Introduction, architecture, applications and challenges **WSNs:** Introduction, architecture, applications, challenges, and recent trends.

Text books:
1. Behrouz A. Forouzan: Data Communications and Networking, 2nd Edition, McGraw-Hill.
2. Andrew S. Tanenbaum, David J. Wetherall: Computer Networks, Pearson.
3. HeshamSoliman: Mobile IPv6 Mobility in Wireless Internet, Pearson Education.

Suggested Books

1. Ashok K. Talukdar: Mobile Computing- Technology, Applications and Service Creation, 2nd Edition, McGraw-Hill.
2. Theodore S. Rappaport: Wireless Communications Principles and Practice, Prentice Hall.
3. KazemSohraby, Daniel Minoli, TaiebZnati: Wireless Sensor Networks- Technology, Protocols and Applications, Wiley.

CST.6104   Advanced Software Engineering   Credits: 4
Objective: This course offers a good understanding of Software Systems and will prepare students to resolve various types of practical problems face by software engineers in the industry. This course helps to design various software quality models.

Learning Outcome: Upon completion of this course, the students will be able to:
- Interpret and prepare the Software Project Plan
- Describe the various concepts of different types of Software Testing
- Measure the Software and Software Quality
- Summarize the Maintenance and Refactoring activities over the code

Unit1   .

Overview of Software Engineering: Phases in development of Software, Software Engineering Ethics, Life cycle Revisited(Incremental Development, Agile Methods, RAD), Model-Driven Architecture, Software Product Line, Process Modelling**.**

Project Management: Project Planning, Project Control (Work Break Down Structure, GANTT Charts, PERT Charts) Project Team Organisation, Risk Management, CMM

Unit 2   .

Testing of OO systems: Objects and Classes, OO Testing, Class Testing, Regression Testing, Non-Functional Testing, Acceptance Testing

Software Reliability: Basic Ideas of Software Reliability, Software Reliability Models, Classes of Software Reliability Models, Orthogonal Defects Classifications

Unit 3   .

Overview of Software Metrics: Measurement in Software Engineering, Scope of Software Metrics, Measurement and Models Meaningfulness in measurement, Measurement quality, Measurement process, Scale, Measurement validation, Object-oriented measurements.

Software Quality: Review, Inspection and Walk through, Software Quality Models, Types of Defects, Cost of fixing the defects, Software Quality Assurance and Control, Challenges in Software Quality, SQA, Process frame work of SQA, ISO 9001:2008, SEI CMMI, Six Sigma**,** Tools for Quality Control (C&E Diagram, Pareto Diagram, histogram, Scatter Plot, Orthogonal Defect Classification)

Unit4   .

Software Maintenance: Maintenance Categories, Major causes of Maintenance Problems, Reverse Engineering, Software Evolutions, Organizational and Managerial Issues of Maintenance activities, Maintenance Measurements

Software Refactoring: Principles of Refactoring, Bad Smells in code, Composing Methods of Refactoring, Moving features between objects, Recent trends in software engineering.

Text book:

1. Roger S. Pressman Software Engineering a Practitioners Approach, McGraw-Hill 8ᵗʰEdition, 2014
2. James S. Peters, WitoldPedrycz, õSoftware engineering an engineering approachö, Wiley India, 2011.
3. AnirbanBasu, õSoftware Quality Assurance, Testing and Metricsö, PHI India, 2015

Suggested Readings:
1. Hans Van Vliet, Yded, 2015. Software Engineering Principles and Practice. Wiley
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandriolo. 2008. Fundamental of Software Engineering. Prentice Hall.

Elective-1

CST.6111   **Data Mining**   **Credits: 4**
Objective: The objective of this course is to ensure that a student learns to understand and implement basic models and algorithms in data warehousing and data mining. The students will learn how to analyze the data and identify the related issues.

Learning Outcome: Upon completion of this course, the students will be able to:

- Describe the concepts related to data warehousing and data mining
- Summarize the dominant data warehousing architectures
- Use information from a variety of different sources and extract knowledge from large data repositories

Unit I

Data Mining Architecture: Data Mining primitives, Task relevant data, interestingness measures, presentation and visualization of patterns, Data Mining Architecture, Basic Statistical Descriptions of Data, Data Generalization and Summarization, Attributed oriented induction, Analytical characterization, Mining class comparisons, Measuring Data Similarity and Dissimilarity

Unit II

Association Rules: Association rules mining, Mining Association rules from single level, multilevel transaction databases, multi dimensional relational databases and data warehouses, Correlational analysis, Constraint based association mining
Advanced Pattern Mining: Pattern Mining in Multilevel, Multidimensional space, Constraint-Based Frequent Pattern Mining, Mining High-Dimensional Data and Colossal Patterns.

Unit III

Classification and Clustering: Classification and prediction, Decision tree induction, Bayesian classification, Rule based Classification, Classification by Support Vector Machine Cluster analysis, Types of data in clustering, Major Clustering Methods: Partitioning Methods, Hierarchical Methods, Density-based methods, Grid-based methods, Model based clustering methods, clustering high dimensional data, clustering with constraints.

Unit IV

Introduction of Mining Complex Data: Complex data objects, Mining spatial databases, Multimedia databases, Time Series and sequence databases, Text databases and World Wide Web, Data Mining Applications, Data Mining and Society, and Case studies based on recent trends in data mining.

Text Book:
1. Han, J., Kamber, M. and Pei, J. 2011. Data Mining: Concepts and Techniques. Elsevier.
2. Berson, A. and Smith S.J. 2008. Data Warehousing, Data Mining, &Olap. Tata McGraw-Hill Education

Suggested Readings:
1. Dunham, M.H. 2008. Data Mining: Introductory and Advanced Topics. India: Pearson Education.

CST.6112   Wireless Networks and Mobile Computing   Credits: 4

Objective: The main objective of this course is to provide the students with basic knowledge and concepts of Wireless Data Transmissions.

Learning Outcome: Upon completion of this course, the students will be able to:
- Identify the basic problems, limitations, strengths and current trends of mobile computing;
- Explain the current wireless networking mechanisms
- Discuss the issues related to developing mobile computing systems and applications;

Unit I

Introduction: History of Wireless Communications, Advantages of Wireless Communication, Disadvantages of Wireless communication, Wireless Network Generations, Comparison of Wireless Systems, Applications of Wireless Communications

Wireless Communication Technology: Signal Encoding Techniques, Overview of Modulation Techniques, Multiple Access Techniques.

Unit II

Wireless Networks: Cellular Wireless Networks, Cordless Systems, Paging and Wireless Systems, Wi-Fi, Wi Max, Hyper LAN and Zig bee.

Wireless Internet: Mobile IP components, process of agent discovery, registration and de-registration, care-of-address, concept of tunnelling, Limitations of Mobile IP, Wireless Application Protocol: WAP Introduction, Protocol Architecture, Components of WAP.

Unit III

Mobile Computing: Mobile communication, Mobile computing, Mobile Computing Architecture, Mobile Devices, Mobile System Networks, Mobility Management.

Mobile Network Layer: Mobile IP: Goals, Assumptions, Entities and Terminology, IP Packet Delivery, Agent Discovery, Registration, Tunneling and Encapsulation, Optimizations, Dynamic Host Configuration Protocol (DHCP)

Unit IV

Wireless Ad hoc Networks (MANETs)
Introduction to Ad hoc wireless networks, applications of Ad hoc networks, **MANETs:** Introduction, secure routing protocols. **VANETs:** Introduction and routing protocols, Wireless sensor Networks, WPAN, Body Area Network, and some current trends in wireless and mobile computing.

Text books:
1. Schiller, J. 2008. Mobile Communications. 2nd ed. India: Pearson Education.
2. Kumar, S., et al. Wireless and Mobile Networks: Concepts and Protocols. Wiley India.
3. Kamal, R. 2009. Mobile Computing. Oxford University Press.

Suggested readings:
1. Talukder, K A., et al. 2008. Mobile Computing, Tata McGraw Hill.
2. Gast S.M.,802.11 Wireless Networks, SPD O₄REILLY.
3. Stojmenovic I.2007, Handbook of Wireless Networks and Mobile Computing, Wiley.
4. Rappaport, T.S. 2009. Wireless Communications. 2nded. India: Pearson Education.
5. Stalling, W. 2009. Wireless Communications & Networks. India: Pearson Education.
Singhal, T L. 2010 Wireless Communication Tata McGraw-Hill Education

CST.6113   **Cloud Computing and Security**   **Credits: 4**

Objective: This course will introduce cloud computing concepts in detail. This course will also explain the concept of virtualization and its role in cloud computing. Storage related issues of cloud computing will also be discussed.

Learning Outcome: Upon completion of this course, the students will be able to:
- Identify the key concepts and challenge in cloud computing

- Describe the role of virtualization in cloud computing
- Classify the storage related issues in cloud computing

Unit I

Introduction to cloud computing: Definition, architecture, deployment models, characteristics and cloud Storage. Evolution of cloud, services, projects and challenges, Companies in the Cloud Today.Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering & Monitoring cloud services, benefits and limitations, Comparison among SAAS, PAAS, IAAS.

Unit II

Virtualization: Introduction to virtualization, concept and properties of virtualization, CPU virtualization, memory virtualization, I/O virtualization, Forms of CPU virtualization, Role of Virtualization in cloud computing, Hypervisors, Virtualization Security concerns.

Scheduling in Cloud: Overview of Scheduling problem, Different types of scheduling, Scheduling for independent and dependent tasks, Static vs. Dynamic scheduling, Optimization techniques for scheduling.

Unit III

Cloud Storage
Overview; Storage as a Service, Benefits and Challenges, Storage Area Networks(SANs), Case Study of Amazon S3

Role of Grid in Implementing Cloud Computing: Basics of Grid Computing, Grid Architecture, Distributed computing in Grid and cloud, Interoperability in Grid and cloud.

Unit IV

Cloud Security
Infrastructure Security: Network Level Security, Host Level Security and Application Level Security;

Data Security: Data Security & Privacy Issues; Identity & Access Management; Legal Issues in Cloud Computing, and New Trends in Cloud Computing.

Text Books:
1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi. 2013. Mastering Cloud Computing: Foundations and Applications Programming. Elsevier Science & Technology.
2. Jamsa, Kris, Cloud computing : Saas, paas, laas, virtualization, business models, mobile, security, and more, Jones & Bartlett Learning (2013)

Suggested Readings:
1. Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter: Cloud Computing: A Practical Approach, McGraw Hill (2010)
2. Magoules, Frederic, Cloud computing : Data-ntensive computing and scheduling, CRC Press (2012)
3. Schulz, Greg, Cloud and virtual data storage networking : Your journey to efficient and effective information services, Auerbach Publications (2011)
4. Velte, Anthony T. Cloud computing, McGraw-Hill Osborne; 1 edition (2009)

Hurwitz J., Bloor R., Kanfman M., Halper F.,2010 Cloud Computing for Dummies, Wiley India.

CST.6114   **Data Analytics and Business Intelligence**   **Credits: 4**

Objective: To understand the concept of Big Data and effective application of business analytics in Business intelligence.

Learning Outcome: Upon completion of this course, the students will be able to:
- Explain the principles of business intelligence
- Discuss various existing technologies for business intelligence
- Describe big data analytics techniques

Unit I

Big Data: Fundamentals, Types, Technology Components, Architecture, Big Data Warehouses, Functional vs. Procedural Programming Models for Big Data.

Introduction to Data Analytics: Data and Relations, Data Visualization, Correlation, Regression, Forecasting, Classification, Clustering.

Unit II

Exploratory and statistical techniques: Cluster analysis, Data visualization, Predictive analysis: Regression, Time series. Analytics concepts and use in Business Intelligence, Data Mining: Hierarchical clustering, Decision tree Text analytics: Text mining. Business View of IT Applications, Digital Data, OLTP vs. OLAP, BI Concepts, BI Roles and Responsibilities, BI Framework and components, BI Project Life Cycle.

Unit III

Big Data Analytics: Framework for Big Data Analysis, Approaches for Analysis of Big Data, ETL in Big Data, Introduction to Hadoop Ecosystem, HDFS, Map-Reduce Programming, Understanding Text Analytics and Big Data, Predictive analysis on Big Data, Role of Data analyst.

Unit IV

Business implementation of Big Data: Big Data Implementation, Big Data workflow, Operational Databases, Graph Databases in a Big Data Environment, Real-Time Data Streams and Complex Event Processing, Applying Big Data in a business scenario, Security and Governance for Big Data, Big Data on Cloud, Best practices in Big Data implementation, Latest trends in Big Data, Latest trends in Big Data, Big Data Computation, More on Big Data Storage, Big Data Computational Limitations, and Current Trends in BI.

Text Books:
1. Minelli M., Chambers M., Dhiraj A. 2013. Big Data, Big Analytics: Emerging Business, Wiley
2. Intelligence and Analytic Trends for Today's Businesses, Wiley CIO Series(2013),1sted.

Suggested Readings:
1. Cindy Howsen, 2008. Successful Business Intelligence: Secrets to making BI and Killer App, Tata Mc-Graw Hill Publishing Company limited
2. Michael Minelli, Michele Chambers, AmbigaDhiraj. 2013Big Data Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley CIO Series
3. Phil Simon. 2013.Too Big to Ignore: The Business Case for Big Data. Wiley and SAS business group.

CST.6150   **Programming in C++**   **Credits: 2**

Students should be asked to implement the object oriented programming using C++ on the following topics:

Tokens, Expressions and Control Structures, Functions in C++, Classes and Objects, Constructors and destructor, Operator Overloading and Type Conversions, Inheritance: Extending Classes, Pointers, Virtual

Functions and Polymorphism, Managing Console I/O Operations, Working with Files, Templates, Exception Handling

CST.6153   **Advanced Computer Networks-Lab**   **Credits: 2**

In this practical class students should be asked to implement scenarios in (Opnet/NS-2/ NS-3) network simulator on the following topics.

Installation of Network Simulator, Introduction to Syntax, looping, conditional check, functions, execution of Mathematical Operations and Execution, Nodes Creation, traffic flows, queuing disciplines and result analysis, Wired and Wireless topology of multiple nodes

CST.6201   **Information Security**   **Credits: 4**

Objective: The main objective of this course is to provide students with an overall understanding of the main concepts of information systems, cryptographic techniques and network security tools and to highlight the importance in modern organizations.

Learning Outcome: Upon completion of this course, the students will be able to:
- Explain the principles of information security and its significance
- Identify the domain specific security issues
- Describe the design and working of different cryptographic methods

Unit I

History of Information Systems: Importance of Information Systems, Basics of Information Systems, Changing Nature of Information Systems, Global Information Systems.
Essential Security Terminologies: Hardware, Software, Defining Security, Need for Security, Cyber-Crimes, Three Pillars of Security.

Unit II

Encryption and Decryption: Attackers and Types of Threats, Encryption Techniques, Classical Cryptographic Algorithms: Monoalphabetic Substitutions such as the Caesar Cipher, Cryptanalysis of Monoalphabetic ciphers, Polyalphabetic Ciphers such as Vigenere, Vernam Cipher, Stream and Block Ciphers.
Symmetric Key Systems: Data encryption Standard (DES), DES Structure, DES Analysis, Multiple DES, Advance Encryption Standard (AES).

Unit III

Key Management Protocols: Solving Key Distribution Problem, Diffie-Hellman Key Exchange Algorithm.
Public Key Encryption Systems: Concept and Characteristics of Public Key Encryption System, Rivest-Shamir-Adleman (RSA) Encryption.

Unit IV

Hash Algorithms: Hash concept, Description of Hash Algorithms (MD5 and SHA-1), Digital Signature/Certificate.
Trojans: Working of Trojans, Different Types of Trojans, Different ways a Trojan can get into a system, Indications of a Trojan Attack.
Recent Trends: Firewall, DMZs, Web Security, Web application Security Auditing.
Text Books:
1. Forouzan, B.A. 2010. Cryptography & Network Security. Tata McGraw-Hill Education.
2. Kahate, A. 2009. Cryptography and Network Security. McGraw-Hill Higher Ed.
3. Godbole, N. 2009. Information Systems Security: Security Management, Metrics, Frameworks and Best Practices. 1st Ed. John Wiley & Sons India.

Suggested Readings:
1. Stallings, W. 2007. Network Security Essentials: applications and standards. 3rd ed. Pearson Education India.
2. Stallings, W. 2014. Cryptography and Network Security: Principles and Practice. 6th ed. Pearson.
3. Kim, D., and Solomon, M. G. 2010. Fundamentals of Information Systems Security. Jones & Bartlett Learning.
4. Elsevier Journal of Information Security and Applications.

CST.6202   **Advanced Database Management System**   **Credits: 4**

Objective: provides the theory and practice of advanced database management systems, and will build upon the student's existing knowledge of Database Systems.

Learning Outcome: Upon completion of this course, the students will be able to:
- Explain and evaluate the fundamental theories and requirements that influence the design of modern database systems.
- Discuss the theory, methods and technologies of relational databases.
- Classify application issues and current trends in database technologies.

Unit I

Introduction: File-Systems, database Approach, Database Environment, Database Languages, Data Models and Conceptual Modelling, Multi-user DBMS architecture, Relational Model and Languages: Relational Algebra and Calculus, SQL, Query-by-Example; Entity-Relationship Modeling, Enhanced Entity-Relationship Modeling, Normalization, Advanced Normalization.

Unit II

Database Issues: Database Security: Threats, Countermeasures, DBMS and Web Security; Transaction Management, Concurrency Control: Serializability & Recoverability, Locking Methods, Timestamping Methods; Database Recovery: Recovery Facilities and Techniques; Query Processing, Query Decomposition, Query Optimization.

Unit III

Distributed and Parallel DBMS: Distributed Database Concepts: Distributed Relational Database Design, Transparencies, Date$\emptyset$s Twelve Rules, Distributed Transaction Management, Distributed Concurrency Control, Distributed Database Recovery, Distributed Query Optimization, Database Replication; Parallel DBMS Concepts: Inter-query and Intra-query Parallelism, Interoperation and Intra-operation Parallelism.

Unit IV

Object DBMS: Object-oriented Concepts, Object-oriented Database Design, Object-oriented Data Models, Object-oriented DBMSs, Issues in OODBMSs, NoSQL Databases: case study.

Data warehouse: Basic Concepts, Multi-tier Architecture, Data Warehousing Modeling: Multidimensional Data Model, Schemas for multidimensional data models, OLAP, Data Warehouse Implementation, Recent Trends in ADBMS.

Text books:
1. Connolly, T. and Begg, C. 2012. Database Systems, 4th Ed. India: Pearson Education.
2. Silberschatz, A. and Korth, H. F. and Sudarshan, S. 2011. Database System Concepts, 6th Ed. McGraw Hill.
3. Desai, B. C. 2010. An Introduction to Database Systems. Galgotia Publications.

Suggested readings:
1. Date, C. J., Kannan, A. and Swamynathan, S. 2012. An Introduction to Database Systems, 8th Ed. India: Pearson Education.
2. Elmasri, R. and Navathe, S. B. 2013. Fundamentals of Database Systems, 5th Ed. India: Pearson Education.\

CST.6203   **Soft Computing**   **Credits: 4**

Objective: To introduce the concept of Neural Networks, Fuzzy Systems, Genetic Algorithms and Hybrid Systems to the students.

Learning Outcome: Upon completion of this course, the students will be able to:
- Explain the fuzzy set theory
- Discuss the neural networks and supervised and unsupervised learning networks
- Describe genetic algorithms

Unit I

Neural Networks: Introduction to Neuron, Modeling Neuron, Feedforward Neural Network, Learning Methods, Data Normalization, Supervised Training Methods, Unsupervised Training Methods, Hopfield Neural Networks, Bidirectional Associative Memory.

Unit II

Fuzzy Systems: Fuzzy Set Theory: Crisp Sets, Fuzzy Sets, Crisp Relations, Fuzzy Relations, Fuzzy Systems: Predicate Logic, Fuzzy Logic, Fuzzy Rule Based System, Defuzzification Methods, Applications.

Unit III

Genetic Algorithms: Basic Concepts, Working Principle, Encoding, Fitness Function, Inheritance Operators, Cross Over, Inversion and Deletion, Mutation Operator, Bitwise Operators, Generational Cycles, Convergence of Genetic Algorithm, Applications.

Unit IV

Hybrid Systems: Introduction to hybrid systems, Fuzzy Associative Memories, Soft Computing Tools and Current trends in Soft Computing.

Text Books:
1. Rajasekaran,S.VijayalakshmiPai, G.A. 2003. Neural Networks, Fuzzy Logic and Genetic Algorithms PHI Learning.

Suggested Readings:
1. Priddy L.K., Keller E.P., 2005. Artificial Neural Networks: An Introduction SPIE Press.
2. Ross J.T., 2009 Fuzzy Logic with Engineering Applications John Wiley & Sons.
3. Gen, M. Cheng, R. 2000. Genetic Algorithms and Engineering Optimization John Wiley & Sons.
   Sivanandam, S. N., Deepa, S. N. 2007. Principles of Soft Computing. John Wiley & Sons.

Elective-1

CST.6211   **Python Programming**   **Credits: 4**

Objective: The objective of this course is to introduce students to the Python programming language.

Learning Outcomes: On completion of the course the students should be able to
- Define python environment and constructs of Python language.
- Explain the various data structures
- Construct scripts in Python language.

Unit1

Python Introduction, Installing and setting Python environment in Windows and Linux, basics of Python interpreter, Execution of python program, Editor for Python code, syntax, variable, types. Flow control: if,

ifelse, for, while, range() function, continue, pass, break. Strings: Sequence operations, String Methods, Pattern Matching.

Unit 2

Lists: Basic Operations, Iteration, Indexing, Slicing and Matrixes; Dictionaries: Basic dictionary operations; Tuples and Files; Functions: Definition, Call, Arguments, Scope rules and Name resolution;
Modules: Module Coding Basics, Importing Programs as Modules, Executing Modules as Scripts, Compiled Python files(.pyc), Standard Modules: OS and SYS, The dir() Function, Packages.

Unit 3

Input output and file handling, Object Oriented Programming features in Python: Classes, Objects, Inheritance, Operator Overloading, Errors and Exceptions: try, except and else statements, Exception Objects, Regular expressions, Multithreading, Networking: Socket module.

Unit4

Role of Python in Hacking and Cyber Forensics, Debugging in python: introduction to PyDBG and immunity debugger; Hooking: Soft Hooking with PyDbg, Hard Hooking with Immunity Debugger, DLL and code injection: Remote Thread Creation, DLL Injection, Code Injection.

Text books:
1. Mark Lutz.,2009, õLearning Pythonö,4th ed., OøREILLY Media, Inc..
2. Justin Seitz,2009, õGray Hat Python: Python Programming with Hackers and Reverse Engineersö, No Starch Press, Inc.

Suggestedreadings:
1. Paul Berry,2011,õHead First Pythonö. OøREILLY Media, Inc.
2. Jeeva Jose & P. Sojan Lal. 2016. Introduction to Computing & Problem Solving With Python.

CST.6212   **Bioinformatics**   **Credits: 4**

Course Objective and Learning Outcomes: Bioinformatics course is being offered to the students as fundamental course to brush up the basics of the students in this important emerging area.
Learning Outcomes: On completion of the course the students should be able to
- Define concepts of data mining, computational and algorithmic tools for biological data analysis
- Classify and resolve biological problems on using computational resources.

Unit I
Biological databases: Nucleotide Sequence Databases, GenBank, DDBJ, EMBL, Sequence Flatfile and submission process, Protein sequence databases, UniProt in detail, Mapping databases, Genomic databases, Data mining.

Unit II
Sequence analysis: Gene Prediction methods and programs, Promoter analysis, RNA secondary structure thermodynamics

Analysis for protein sequences: Predicting features of individual residues, Predicting function, Neural networks, Protein structure prediction, Protein structure databases, PDB in detail, 3D visualization softwares

Unit III

Inferring relationships: Global Vs. local sequence alignments, Dotplots, Scoring matrices, Pairwise sequence alignment, BLAST, Position-Specific scoring and PSI-BLAST, MegaBLAST, BL2SEQ, BLAT, FASTA Vs BLAST

Unit IV

Modelling and structure: From protein sequence to structure, theoretical and practical aspects of protein sequence alignments, secondary, tertiary structure prediction, comparative modeling, Docking, protein-protein and protein-ligand docking, and recent trends in Bioinfomatics.

Text books

1. Baxevanis, A.D. and Ouellette, B.F.F. (2005). *Bioinformatics: A Practical guide to the Analysis of Genes and Proteins*. Wiley-Interscience, USA.

2. Hall, B.G. (2011). *Phylogenetic Trees Made Easy: A How-To Manual*. Sinauer Associates, Inc. USA.

Suggested reading

1. Lesk, A.M. (2008). *Introduction to Bioinformatics*. Oxford University Press, UK.

2. Zvelebil, M. and Baum, J. (2007). *Understanding Bioinformatics*, Garland Science, New York, USA.

3. Ramsden, J. (2010). *Bioinformatics: An Introduction* (*Computational Biology*). Springer, India.

4. Ye, S.Q. (2008). *Bioinformatics: A Practical approach*. Chapman & Hall/CRC, UK.

5. Mount, D. (2012). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press.

6. Graur, D., Li, W. H. (2000). Fundamentals of Molecular Evolution. Sinauer Associates.

7. Tisdall, J. (2001). Beginning Perl for Bioinformatics. O¢Really Publishers.

8. Orengo, C., Jones, D., Thornton, J. (2005). Bioinformatics: Genes, Proteins and Computers (Advanced Texts). Taylor and Francis Publishers.

CST.6213   **Advanced Web Technologies**   **Credits: 4**

Objective: The subject provides knowledge to learn and implement the various web programming technologies of current trend today.

Learning Outcome: Upon completion of this course, the students will be able to:
- Explain the current technologies in Internet world
- Develop client side and server side programming
- Describe various web development frame works

Unit I

Introduction: Introduction to Java, Difference between C/C++ and Java, Applets and Applications, Java Development Kit, Advantages of Java, Data types, modifiers, expressions, operators in Java, Control Statements in Java, Classes statements in Java, Classes, Inheritance (single, multilevel, hierarchical), Multiple Inheritance using Interfaces, Arrays, Strings and Vectors, Java packages, Exception handling, Multithreading, Applets, Graphics and AWT.

Unit II

Name services and configuration: DNS, DHCP, X500 Directory Services, LDAP, Internet Security, Authentication and Encryption, Watermarks, Firewall, SSL, Digital Signatures. Web Services: Web services, Evolution and differences with Distributed computing, XML, WSDL, SOAP, UDDI, Transactions, Business Process Execution Language for Web Services, WS-Security and the Web services security specifications, WS-Reliable Messaging, WS-Policy, WS-Attachments. Web 2.0 technologies: Introduction to Ajax, Ajax Design Basics, JavaScript, Blogs, Wikis, RSS feeds.

Unit III

Content delivery and preparation: Introduction to WWW, TCP/IP, HTTP, FTP, UDP, NTier, Markup Languages VRMLó HTML, DHTML, DNS, URL, Browsers, Platform for Web Services Development, MVC Design Pattern, .NET, .NET framework.

Unit IV

Dynamic web programming: Java Applets, Java script, JSP, JSTL, ASP, , Servlets, Servlet Life cycle, Component Technologies, Java beans, CORBA, Introduction to EJBs, JDBC, Secure Electronic Transactions over Web, PHP, CSS, SQL queries, Case Studies: WAMP, LAMP, MAMP and XAMPP, and Recent trends in Web Tehnologies.

Text Books:
1. Balagurusamy, E. 2009. Programming With Java. 4th ed. Tata McGraw-Hill Education.
2. Ladd, E. and O'Donnell, J. 2001. Platinum Edition Using Xhtml, Xml and Java 2. 4th ed.Que Publishing.

Suggested Readings:
1. Deitel, P.J., Deitel, H. and Deitel, A. 2011. Internet and World Wide Web How toProgram. 5th ed. India: Pearson Education, Limited.
2. Miller, M. August 2008. Cloud Computing: Web-Based Applications That Change theWay You Work and Collaborate Online. Que Publishing.

Elective-2

CST.6214	Biometric Security	Credits: 4

Objective: The main objective is to make the students understand the problems with traditional security systems and introduce the concept of biometric security systems.

Learning Outcomes: Upon completion of this course, the students will be able to:
- Describe the theory of biometric security
- Classify algorithms related to various biometrics
- Evaluate the performance of various biometric systems

Unit I

Biometrics Introduction: Benefits of biometrics over traditional authentication systems, Benefits of biometrics in identification systems, Comparison of various biometric traits, Applications. Key biometric terms and processes: biometric verification and identification, how biometric matching works.

Unit II

Physiological Biometric Technologies: Fingerprints: Working, characteristics, Competing technologies, strengths, weaknesses and deployment.

Facial scan: Working, Strengths, weaknesses and deployment. Advanced Topics: Handling pose, illumination, and expression variations, Heterogeneous face recognition, Face modelling.

Iris Scan: working, strengths, weaknesses and deployment.
Voice Scan: Working, characteristics, strengths, weaknesses and deployment, GAIT Pattern.

Unit III

Behavioral Biometric Technologies: Handprint Biometrics, Signature technology: Technical description, classification, keystroke-scan.
Repositories for Database and Template Storage: Features and Capabilities of a DBMS, Biometric data and databases, database issues, Biometric databases.

Unit IV

Security of Biometric Systems: Adversary Attacks, Attack on biometric processing, Attacks on the template database, Database security, Template security techniques.
Advanced Topics in Biometrics: Biometrics in Internet-Ecommerce, Integrated Biometrics, VLSI Biometrics.
Text books:
1. Jain, A. K., Ross, A. A. 2011. Introduction to Biometrics. Springer Science & Business Media.
2. G.R. Sinha, Sandeep B. Patil. 2013. Biometrics: Concepts and Applications. Wiley India.

Suggested readings:
1. Chirillo, J. and Blaul, S. 2003.Implementing Biometric Security. Wiley.
2. Wang, P. S. P. 2012. Pattern Recognition, Machine Intelligence and Biometrics. Springer Science& Business Media.
3. Nanavati, S., Thieme,M.and Nanavati, R. 2002. Biometrics: Identity Verification in a Networked World. John Wiley & Sons.

CST.6215   **Secure Coding**   **Credits: 4**
Objective: This course aims to provide an understanding of the various security measure required for the source code of software and major coding errors that lead to vulnerabilities.
Learning Outcome: Upon completion of this course, the students will be able to:
- Identify the elements of secure coding
- Describe various security attacks possible
- Classify various errors that lead to vulnerabilities

Unit1

Software Security: Security Concepts, Security Policy, Security Flaws, Vulnerabilities, Exploitation and Mitigations. Software Security problems, Defensive program is not enough, Quality Fallacy, Classification of Vulnerabilities.
Security Analysis: Problem Solving with static analysis: Type Checking, Style Checking, Program understanding, verifications and property checking, Bug finding and Security Review. Analysing Source versus Analyzing Compiled code.

Unit 2

Strings: Common String manipulating Errors, String Vulnerabilities and Exploits, Mitigation Strategies for strings, String handling functions, Runtime protecting strategies, Notable Vulnerabilities.
Integer Security: Integer data Type, Integer Conversions, Integer Operations, Integer Vulnerabilities, Mitigation Strategies.

Unit 3 .

Handling Inputs: What to validate, How to validate, Preventing metadata Vulnerabilities,
Buffer Overflow: Introduction, Exploiting buffer overflow vulnerabilities, Buffer allocation strategies**,** Tracking buffer sizes, buffer overflow in strings, Buffer overflow in Integers Runtime protections
Errors and Exceptions: Handling Error with return code, Managing exceptions, Preventing Resource leaks, Logging and debugging

Unit4 .

Privacy and Secrecy: Privacy and regulations, outbound passwords, Random Numbers, Cryptography, Secrets in memory

Recommended Practices for Secure Coding: Security development Life cycle, Security Training, Practices of secure code for Requirement, Design, Implementation, Verification of source code, and some other recent trends.

Text books:
1. Robert C. Seacord, Secure Coding in C and C++, published by Addison Wisley for Software Engineering Institute, 2nd edition, 2013.
2. Brian Chess & Jacob West, õSecure Programming with static Analysisö, published by Addison Wisley Software Security Series, 2007

Suggested Readings:
1. Seacord, Robert C. The CERT C Secure Coding Standard Pearson Education, 2009

2. LeBlanc, D. and Howard, M. 2002. Writing Secure Code. 2ndEdition. Pearson Education.

3. Android Secure Coding:
   https://www.securecoding.cert.org/confluence/display/seccode/SEI+CERT+Coding+Standards

CST.6216	Digital Image Processing	Credits: 4

Objective: TheObjective of this course is to ensure that a student learns the fundamentals of digital image processing, starting from image capturing to image enhancement, restoration and compression.

Learning Outcome: Upon completion of this course, the students will be able to:
- Define image formation and perception of gray and color image data
- Discuss techniques in image enhancement and image restoration
- Describe image compression, segmentation and watermarking

Unit I

Introduction: Fundamental steps in Image Processing System, Components of Image Processing System, Elements of Visual Perception, Image Sensing and acquisition, Image sampling & Quantization, Basic Relationship between pixels, Color Fundamentals, Color Models, Color Transformations.

Unit II

Image Enhancement Techniques: Spatial Domain Methods: Basic grey level transformation, Histogram equalization, Image subtraction, image averaging, Spatial filtering: Smoothing, sharpening filters, Laplacian filters, Frequency domain filters, Smoothing and sharpening filters, Homomorphism filtering.

Image Restoration & Reconstruction: Model of Image Degradation/restoration process, Noise models, Spatial filtering, Inverse filtering, Minimum mean square Error filtering, constrained least square filtering, Geometric mean filter, Image reconstruction from projections.;

Unit III

Image Compression: Redundancies- Coding, Interpixel, Psycho visual; Fidelity, Source and Channel Encoding, Elements of Information Theory; Loss Less and Lossy Compression; Run length coding, Differential encoding, DCT, Vector quantization, Entropy coding, LZW coding; Image Compression Standards-JPEG, JPEG 2000, MPEG; Video compression.

Wavelet Based Image Compression: Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation,

Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding,

Unit IV

Image Segmentation: Discontinuities, Edge Linking and boundary detection, Thresholding, Region Based Segmentation, Watersheds; Introduction to morphological operations; binary morphology-erosion, dilation, opening and closing operations, applications; basic gray-scale morphology operations; Feature extraction; Classification; Object recognition.

Digital Image Watermarking: Introduction, need of Digital Image Watermarking, applications of watermarking in copyright protection and Image quality analysis.

Text Books:
1. Gonzalez, R.C. and Woods, R.E. 2009. Digital Image Processing. 2nd ed. India: Person Education.

Suggested Reading:
1. Pratt, W. K. 2001. Digital Image Processing. John Wiley.
2. Jayaraman, S., Veerakumar, T. and Esakkiranjan, S. 2009. Digital Image Processing. Tata Mcgraw-Hill.

CST.6252   Advanced Database Management System-Lab   Credits: 1

Students will be performing practicals on the following topic in ADBMS Lab:

Single line and group functions for a table,DDL, DML and DCL Commands, TCL Commands, Create and manipulate various DB objects for a table, Create views, partitions and locks for a particular DB, PL/SQL procedure using exception handling, PL/SQL procedure using cursors, prepare reports using functions, PL/SQL block for transaction operations of a typical application using triggers and package, table for various relations, Implement the query in SQL for insertion, retrieval, updation, deletion, Writing Triggers, Implementing operation on relation using PL/SQL., Creating Forms, Design and develop an application using any front end and back end tool (make use of   ER diagram and DFD).

CST.6261   Elective- 1 Lab   Credits:1

Students will be performing practical assignments based on Elective 1 selected by them and programming assignment given by the respective elective subject teacher.

SEMESTER- III

CST.6399   **Research Seminar**   **Credits: 2**

The students should be guided to prepare and deliver the content effectively to the audience.   The students will choose the topic in consultation with the Supervisor.

CST.6300   **Pre-Dissertation**   **Credits: 16**

Objectives:

1. The student shall have to write his synopsis including an extensive review of literature with simultaneous identification of scientifically sound (and achievable) objectives backed by a comprehensive and detailed methodology. The students shall also present their synopsis to the synopsis approval committee. The Evaluation criteria will be as detailed below:

Evaluation Parameter	Maximum Marks
Review of literature	40
Identification of gaps in knowledge and Problem Statement	60
Objective formulation & Methodology	60
Presentation	40
Total	**200**

2. The second objective of Pre-Dissertation would be to ensure that the student learns the nuances of the scientific research. Herein the student shall have to carry out the activities/experiments to be completed during Pre-Dissertation (as mentioned in the synopsis).

   The students would present their work to the Evaluation Committee (constituted as per the university rules). The evaluation criteria shall be as detailed below:

Evaluation Parameter	Maximum Marks	Evaluated By
Mid Term Review and Presentation	100	Evaluation Committee
Continuous evaluation	100	Supervisor
Total	**200**	
Total Objective 1 + Objective 2	**400**	

SEMESTER IV

CST.6400   **Dissertation**   **Credits: 16**

In Dissertation the student shall have to carry out the activities/experiments to be completed during Dissertation (as mentioned in the synopsis). The students would present their work to the evaluation Committee (constituted as per the university rules). The Evaluation criteria shall be as detailed below:

Evaluation Parameter	Maximum Marks	Evaluated By
Parameters by External Expert	100	External Expert
Presentation and defence of research work	150	Evaluation Committee (DAA, Dean SET, CoC, Supervisor)
*Research Publication out of the research work (50) Continuous evaluation (100)	150	Supervisor
Total	400	

*Instructions to award marks/grades for Research Publication:

S. No.	Grade	Condition
1	50	Publication from Dissertation in SCI indexed journal.
2	45	Publication from Dissertation in Scopus indexed journal.
3	35	Publication from Dissertation in Proceedings of Conference which is Scopus indexed. Publication from Dissertation in ACM/Springer/Elsevier/Inderscience/IEEE portal.
4	30	Presented paper in International Conference.
5	25	Presented paper in National Conference.

Certificate

The Board of Studies for Computer Science & Technology certifies that the syllabus of M.Tech in Computer Science & Technology (Cyber Security) has been designed in alignment with the Choice Based Credit System (CBCS) of UGC.

The percentage of foundation, core, and elective courses for this programme are given below:

Course Type	Percentage of course type in the Programme	Percentage of course type required under CBCS
Foundation Courses	10	10% - 15%
Core Courses	55	50%-65%
Elective Courses	35	25%-35%

Dr. Amandeep Kaur
Chairperson (Ex-officio)

Dr. Rama Krishna Challa
(Member)

Dr. Anil Kumar Verma
(Member)

Er. Meenakshi
(Member)

Er. Surinder Singh Khurana
(Member)